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STEM FOR GIRLS FROM LOW INCOME FAMILIES: MAKING DREAMS COME TRUE

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ABSTRACT

Sixty two million girls are being denied education worldwide (Yousafzai, 2015). Unfortunately, this is not a new trend. Neither is it a diminishing one. In the UAE, although on an average more girls are enrolled in schools than boys, with approximately 126000 girls to 112000 boys, about 1100 girls dropped out of school when compared to 460 boys between years 2013-2014 (Hanif, 2015). There have been host of initiatives within the country by government and non-government agencies to increase awareness towards female education and particularly towards STEM higher education and employment opportunities. However, these initiatives do not often reach the schools that target low-income families in the country. This paper reports findings from the phase one of a pilot study carried out with 235 female students belonging to low-income expatriate families living in the UAE. Using qualitative and quantitative methods, based on Microsoft Corp. survey on students that commissioned Harris Interactive to carry out two national surveys of K-12 parents and students on STEM education (Microsoft Corp., n.d.), a five-year plan is followed in this study. As a result, it highlights the significant gap in knowledge and understanding of parents in lower income bracket towards STEM education for girls. It also reports on the successful transition of 43% of the girls into STEM school education all the way to STEM higher education through dedicated summer workshops and internships provided through consulate grounds and local universities, as opposed to typical choices between completing high school and getting married, or going into non-STEM field such as social/fashion/business studies/etc. This research result highlights the strength of holistic, non-profit initiatives and approaches that can still bring in the desired results in increasing number of girls from low-income families pursuing STEM education and career, which can definitely be incorporated into educational policies of a country.

JEL Classifications: I2, O15

Keywords: STEM Education, Female Girls, Gender, Equality, Education, Gender Gap

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INTRODUCTION

Despite progressive efforts by United Nations, governments and non-government organizations world-wide, gender equality is a pressing issue and a global priority for UNESCO (UNESCO, 2016). Girls continue to be the more disadvantaged than boys, so much so that some 62 million girls are still being denied education (Yousafzai, 2015). Although gender equality in education has been achieved in most OECD countries, it is prominent in income poor countries and income poor within the countries (OECD, 2011; World Bank, 2001; 2011).

Research has further shown that although there is no difference between girls and boys in terms of performance in science related areas, girls have been shown to perform better than boys in literacy while boys outperform girls in maths (OECD, 2011). What is more, research has shown that girls are less likely to choose Science, technology, Engineering or Mathematics (STEM) subjects to pursue in

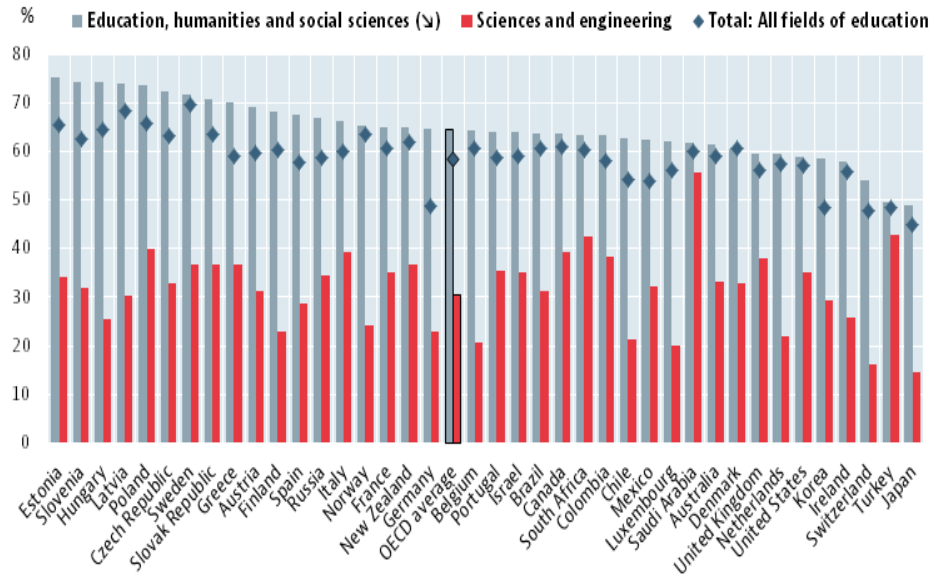
higher education even if they manage to complete high school as shown in figure below (OECD, 2011).

The issue of gender inequality in education is often a cause of and a sign of larger inequalities in the society. UNICEF strongly states that achieving gender equality in education is in the forefront of breaking the cycle of gender discrimination, giving girls opportunities beyond early marriage and child birth (UNICEF, 2015). Glewwe and Kremer posit that ensuring gender equality in education improves girls' opportunities vocationally, their social and living status and the overall economic growth of the nation (Glewwe & Kremer, 2006). Song and Appleton have suggested that ensuring education in girls also reduce population growth, increase child health and expenditure towards better living (Song & Appleton, 2006). Gender difference in graduates across fields of study is significant because it significantly impacts gendered life and vocational choices as well as earnings (OECD, 2015). Research has further suggested that girls develop very different educational and work orientations during schooling years when parents play a major role in decision-making and motivating students which have impact on their life choices (Tai, et al., 2006).

In the United Arab Emirates (UAE), although on an average more girls are enrolled in schools than boys, with approximately 126000 girls to 112000 boys, about 1100 girls dropped out of school when compared to 460 boys between years 2013-2014 (Hanif, 2015). Although there are initiatives within the country by government and non-government agencies to increase awareness towards female education and particularly towards STEM higher education and employment opportunities, these initiatives do not often reach the schools that target low-income families in the country.

This research paper proposes to identify gaps in low-income bracket parents' knowledge and attitude of the importance of STEM education for girls and then reports the impact of a pilot study conducted with 235 female students belonging to low-income expatriate families living in the UAE, over a period of five years. It aims to study the impact of dedicated summer workshops and internships provided through consulate grounds and local universities to enhance parents' knowledge and understanding by facilitating learning and understanding in female students.

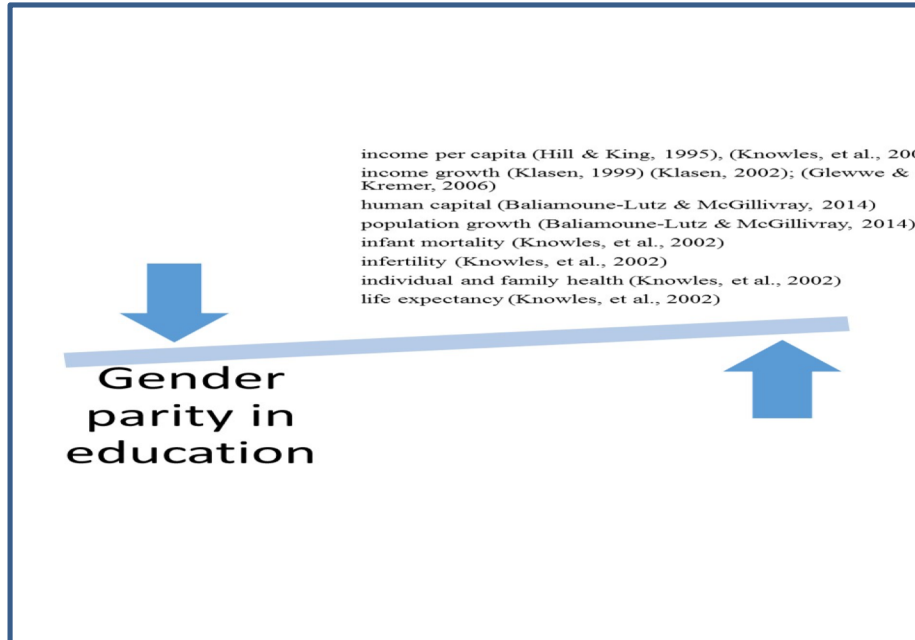
**FIGURE 1: SHARE OF FEMALE BACHELOR'S GRADUATES
BY FIELD OF STUDY**



(Source: (OECD, 2015))

GENDER ISSUES IN EDUCATION

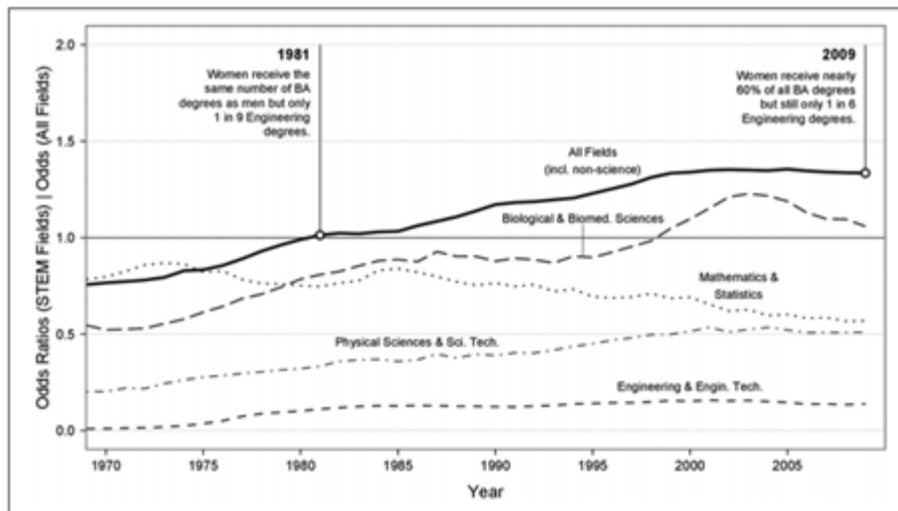
According to the American Psychological Association, the word gender is used to refer to the behaviours, feelings and attitudes associated with an individual's sex, particularly as defined by their culture's perceptions of what they should or should not do (American Psychological Association, 2011). Gender discrimination refers to inequality in various spheres of life against a particular sex, ranging from inequality in treatment, health care, education, discrimination at work places and so on (Otu & Nkamare, 2012). Gender issues in education is a global concern that has been at the forefront of priorities for both government and non-government agencies such as UNESCO, OECD, IDRA and so on. Almost half the world's female children are not in schools, particularly from South Asia and Sub-Saharan (World Bank 2011). Existing literature on the impact of gender disparity in education posits increasing inequality on the following (see FIGURE 2 below).

FIGURE 2: IMPACT OF GENDER DISPARITY IN EDUCATION

STEM Education and Gender issues

Through numerous efforts, gender disparity in education has reduced, albeit slowly (Bushmann & DiPrete, 2006; Legewie & DiPrete, 2009). Zeng et al. in their study reported that from 1999 to 2005 only a third of the 181 countries had achieved gender parity, and that most were developed nations (Zeng, et al., 2013). However, even in developed nations, research shows that girls are less likely to pursue further education in STEM compared to boys (Hyde, et al., 2008). Although most schools provide preparation for further education in STEM, girls seem more oriented towards Sociology, English, etc. whereas boys are more inclined to pursue careers in STEM as illustrated in Figure 3. Furthermore, studies have shown that school years play major role in deciding for girls which career path they will choose (Legewie & DiPrete, 2014).

Many posit that it is imperative to encourage more girls towards STEM education and ultimately STEM careers. Margolis and Fisher suggested that predominantly male scientists tend to exclude problems in the society that pertain to women and children (2002). For instance, the first generation of airbags in cars were tailored to the average male body as it was engineered by male scientists leading to inevitable deaths of women and children (Margolis & Fisher, 2002). Similarly, the gap in wages that arise between male and female employees could also be tackled by encouraging more girls to take up STEM education so they could take up jobs in this field which are many and highly paid (Islam, 2014).

FIGURE 3: GENDER GAP TRACKED FROM 1969 TO 2009

Source: Digest of Educational Statistics (2009:Tables 268, 299, 303, 305, 312, and 313).

Note: The trend line for all fields shows the odds that a BA degree is awarded to a woman, and the lines for the different subfields show the female/male odds ratio for the respective STEM field.

(Source: Digest of Educational Statistics, 2009 as qtd. in (Legewie & DiPrete, 2014))

UNITED ARAB EMIRATES AND GENDER ISSUES IN EDUCATION

The United Arab Emirates (UAE) is geographically located in the Middle East. It is a young nation, celebrating 45 years since birth. It comprises seven emirates. The country is strategically located to enjoy the technology of the West and the cultures of the East. Total population of the UAE as of 2014 was 9.5 million with almost 85% expatriate population (Trading Economics, 2016). According to the UN Department of Economic and Social Affairs, the UAE has the second highest ratio of male to female population at 228.2, after Qatar (UNDESA, 2015), a disparity that has been attributed to a large expatriate male unskilled workers in the construction and other industries.

Due to the government's projects aimed at reducing gender disparity, the UAE's ICT sector and generally the STEM sector has seen a 56.8% women graduates from government universities (Badri, 2015). The UAE also features with pride women in STEM jobs such as pilots, crane operators, tram operators (Badri, 2015). However, reports by World Bank have highlighted a continued disparity of women in STEM, quoting 4.1% of companies showcasing female managers in STEM, not only in the UAE, but in the region (Badri, 2015). In addition, efforts are focusing on the Emirati girls and women, but not the expatriate population. World Bank report further suggests such a disparity is hampering the nation's productivity and income (Badri, 2015).

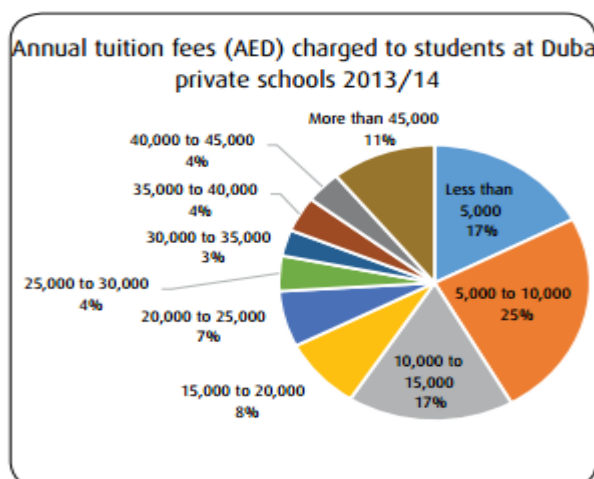
Low income families and education in UAE

UAE has a range of income levels, particularly for expatriates. Tong (2010) highlighted UAE as emerging economy, focusing more on energy and service sector but also diversifying. The workforce boasts a small portion of high-skilled,

knowledge workers such as doctors, manager and such who enjoy high pay and attractive perks, while the majority 'are low-skill, low-paid, making an average one-sixth of salaries' compared to the former group (Tong, 2010). Visa rules in the nation allow workers with a UAE Dirham 4000 monthly salary to sponsor immediate family members to live in the country with the sponsor (Rasheed, 2014).

Education sector in Dubai has over 500 international schools with varying curricula. The city boasts 200,000 student population across private and public schools (National Qualifications Authority, 2013). 90% of the population belongs to private sector, that is managed by the Knowledge and Human Development Authority in Dubai (KHDA) which inspects schools annually to decide on school standing depending on engineering, incentives and accountability (Thacker & Cuadra, 2014). The government expends grants to ensure both enhancement of education and enhancement of gender parity in public school sector (Khan, et al., 2015). So private schools range in fees and quality of education provided to parents as seen below:

FIGURE 4: ANNUAL TUITION FEES CHARGED BY SCHOOLS IN DUBAI



(Source: (KHDA, 2014))

Families from low-income jobs look to schools with low tuition fees. Due to financial constraints, these schools lag behind expensive ones, especially without state-funding to enhance opportunities, ICT services and facilities (Khan et al., 2015). There is little or no studies that reveal the gender distribution among students in private schools.

RESEARCH OBJECTIVES

Based on the literature review and the current state of gender disparity in the UAE, the proposed research objective of the study is:

- to identify gaps in low-income bracket parents' knowledge and attitude of the importance of STEM education for girls
- to study the impact of a pilot study conducted with 235 female students belonging to low-income expatriate families living in the UAE, over a period of five years

METHODOLOGY

The objective of the study was two folds and followed both qualitative and quantitative methods. A five-year plan put into motion is explained below:

Step 1: Collaboration

Consulates	approached two South-Asian nation's Consulates. One accepted invitation to become involved in the program, upon full confidentiality
Universities	approached three private universities. One accepted invitation to become involved in the program, upon full confidentiality
Students	approached 1000 female students' parents. 300 showed interest. Only 235 female students' parents responded and agreed to participate upon full confidentiality

Step 2: Poll

Survey was developed based on the Microsoft Corp. survey on students that commissioned Harris Interactive to carry out two national surveys of K-12 parents and students on STEM education (Microsoft Corp., n.d.), and run on 235 female students whose parents provided permission and consent to participate. No identifying data collected to ensure anonymity. The survey asked students to answer three questions:

- Student's Grade/Year in School
- What are your career aspirations after you complete school?
- Select one reason that best suits why you have chosen the above answer

Step 3: Parents Knowledge and Attitude

To identify gaps in low-income bracket parents' knowledge and attitude towards STEM education, survey was prepared based on the study done by Microsoft Corp. The items were tested on a 5-point Likert-scale. Three sections were used, ensuring anonymity of respondents:

- **First section** captured salary, number of children, and number of female children.
- **Second section** recorded parents' response to their perception and knowledge of STEM education
- **Last section** recorded parents' attitude/aspirations towards their daughters' educational orientation towards STEM education.

Step 4: Workshops and Focus groups

WORKSHOPS	A series of two-hour workshops in the first cycle of the program targeted at parents. The purpose of the workshops was to enhance parents' knowledge and understanding of STEM education, career opportunities for girls, impact of STEM education on female students, their health, fertility, income, status. These workshops were run over two months during summer holidays, once a week, totalling eight sessions.
FOCUS GROUP	In the last session, a focus group was run to capture their feedback, knowledge and perception of STEM.
Follow Up	<p><i>Following summer</i> Series of workshops were conducted for the female students across two months to encourage conversation in career aspirations, options, opportunities, possible implications, benefits.</p> <p>Workshops were run over <u>two months</u> during summer holidays, once a week, totalling eight sessions.</p> <p><i>Last Session</i> A focus group was run to capture their feedback on possibility of pursuing STEM education.</p>

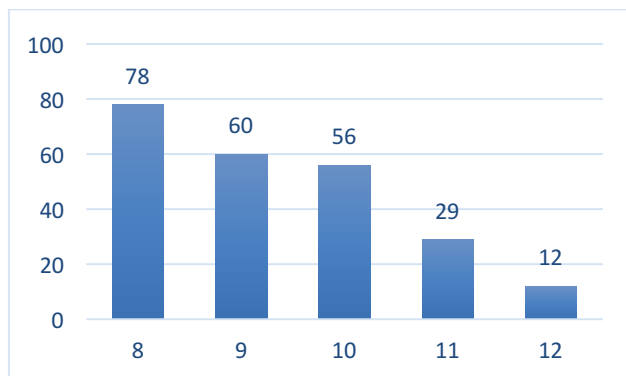
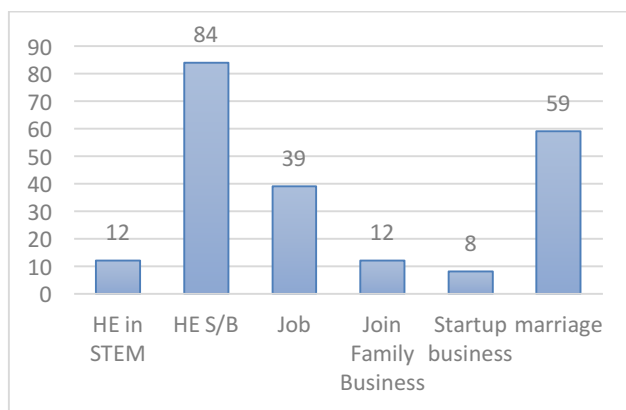
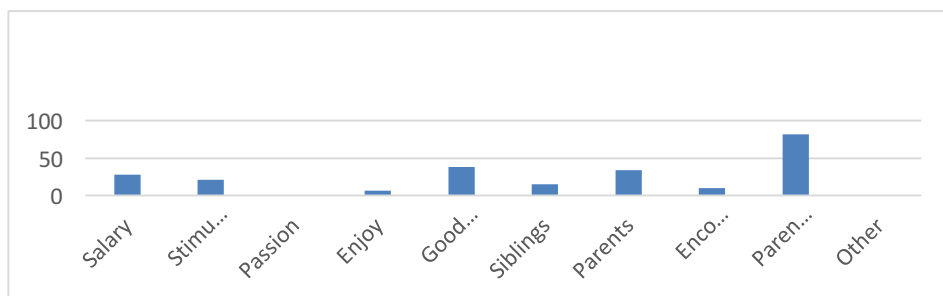
Step 5: Tracking Aspirations

Tracking	Throughout the next three years, the 235 girls were tracked for their career options through subjects chosen, grades received and ultimately post-school decisions.
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RESULTS AND ANALYSIS

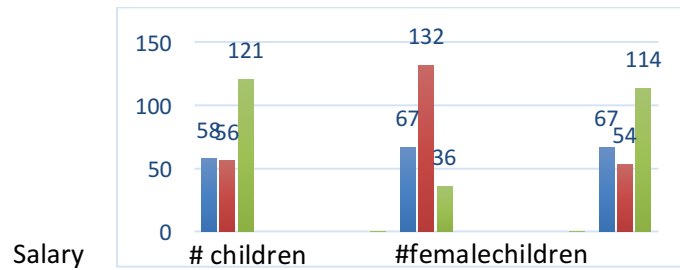
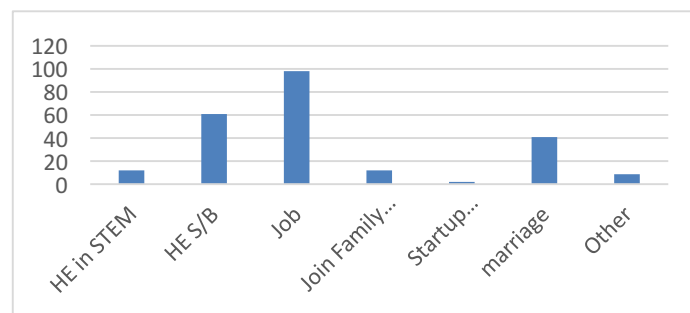
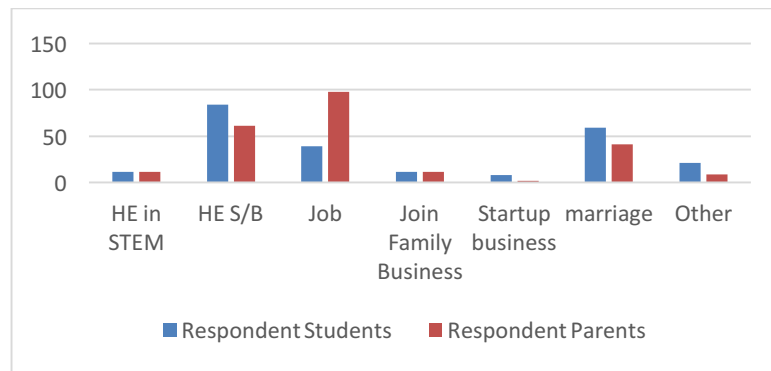
Sample population that responded constituted 235 female students and their parents. 65 female students' parents did not consent to participating in the study. Response rate was 78% which is accepted as valid and viable as school population was more than 2000 (Nulty, 2008).

Results for the student poll

FIGURE 5: STUDENT RESPONDENTS BY GRADE/YEAR**FIGURE 6: STUDENT RESPONSES TO ASPIRATIONS AFTER SCHOOL****FIGURE 7: STUDENT REASONS FOR AFTER-SCHOOL ASPIRATIONS**

Results showed only 12 out of 235 students admitted to wanting to pursue a career in STEM. Aspirations included higher education in social sciences, business, then marriage, then jobs, in that order. The prevailing reason admitted by the female respondents was that their parents had told them to follow that path, followed by 'good grades', 'parents' being in the same field and 'salary'.

Results from parents' surveys

FIGURE 8: PARENTS' DEMOGRAPHIC RESULTS**FIGURE 9: PARENT RESPONSES TO ASPIRATIONS AFTER SCHOOL****FIGURE 10: COMPARING PARENT AND STUDENT RESPONSE TO ASPIRATIONS**

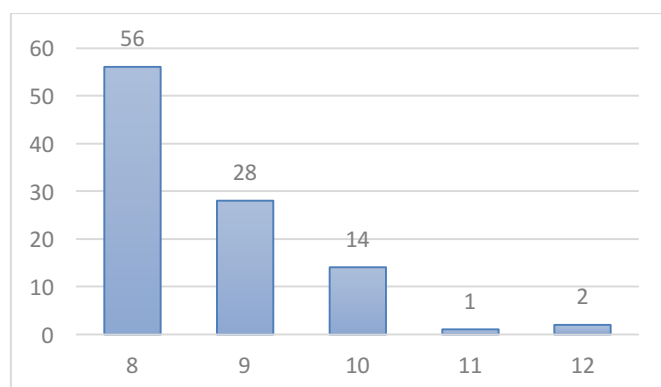
Results showed:

- majority of the parents were from the lower income bracket, with salary <10,000. Majority of them had 1-2 children and majority had a female child.
- On questions of knowledge and perceptions, 56% of the parents did not understand what STEP education was or why it was important for girls
- 5% of Parents who did feel STEM education was important.
- 76% of parents who were interested to have their daughters pursue STEM education, did not think the schools were adequate for such future aspirations
- 50% of parents who were interested to have their daughters pursue STEM education, did not think they had enough to spend on further education in this field
- Top three choices for aspirations that parents chose for their daughters were Job, higher education in social/business studies and then marriage.
- There was some correlation between parents who knew about STEM education and wanted their daughters to pursue further education in STEM. However, only 17% of parents wanted their girls to get married than the 25% female students' choice of marriage.
- 36% of students wanted to pursue higher education in social/business studies whereas only 26% of the parents wanted their children to pursue that option
- 41% of parents wanted their daughters to pursue a job after school whereas only 17% of the students chose to pursue jobs after school.

Tracking Aspirations

Based on post-workshop focus group interviews with parents and female students, and based on students' grades, high school subject choices and ultimately HE choices, it was recorded that, after the five-year workshop programme, a total of 101 students of the 235 students chose to pursue a STEM education. Of these, two students were from the Grade 12 batch and one was from Grade 11 all of whom graduated successfully from local universities in the UAE with STEM degree. Other students have graduated high schools and either joined STEM degrees in local or international universities across the globe as shown below:

FIGURE 11: FEMALE STUDENTS WHO WERE PART OF THE PROGRAM AND PURSUED STEM HIGHER EDUCATION



DISCUSSIONS AND CONCLUSIONS

Gender issues in education is a priority concern for governments, non-government organizations, and companies, schools and parents world across. Although in recent years, the gap has reduced in the western world, a more glaring gap exists in STEM education. Although girls do better in school in STEM subjects, their aspirations do not seem to lead towards further STEM education or career, thus leading to further discriminations and issues in terms of inequality, health, fertility, income, country growth and so on. This study carried out a literature review of gender issues in education in the UAE and highlighted the need to study parents' knowledge, awareness and attitude towards female students' pursuing STEM education, particularly those from the lower income bracket in private schools.

The findings highlight that majority of female students did not aspire to pursue STEM education whether they were in eighth grade or twelfth. The number of respondents reduced considerably from eighth grade to twelfth. This was probably because as they got closer to completing high school, they had already chosen their career path with particular subjects. Furthermore, it was interesting to note that although students quoted parents' will as reason for their choices, more parents actually wanted their daughters to pursue a job after school than either marriage or a degree. This was attributed mainly to the average income of the household and so parents wanted their children to become wage-earners after school. It is also interesting to note that although parents felt the school was not adequately equipped to support their daughters' aspirations towards STEM education, they themselves were also not willing to spend from their own money to pursue such career paths for their daughters. The most interesting finding was the majority of the parents were either not aware or did not see the importance of STEM education for their daughters.

As a result of the workshop series over the two years, 101 students chose to pursue STEM education. Of these three graduated with STEM degrees and one has already found placement at an organization. It is also interesting to note that majority of the 101 students who decided to follow a career path in STEM were from the original eighth grade batch. This could imply that the younger the female students, more inclined their parents and themselves in making the choice.

The results from this study are very positive and encouraging. Decimating gender gap in STEM education is crucial, not just for students from high-income families, but also for students from low-income families. This study has highlighted how with a series of interactive, holistic workshops that include both parents and students, it is possible to get encourage female students to successfully pursue STEM education after school.

FURTHER STUDY AND LIMITATIONS

It is important to note here that the sample size for the pilot study was fairly small, 235 girls and their parents. Although it was still an acceptable response rate, author believes it is important to extend the study to include more schools and more students and their parents in order to test if the results may be replicated and by doing so, establish the method as a holistic approach to encouraging more girls towards STEM education in the country.

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